POPULATION CHARACTERISTICS OF HUMPBACK WHALES IN GLACIER BAY AND ADJACENT WATERS: 1995

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ABSTRACT

Fifty-eight individual humpback whales (*Megaptera novaeangliae*), including 3 calves (5.2 %) were photographically identified in Glacier Bay and Icy Strait between June 1 and August 31, 1995. Of these whales, 13 (22%) were seen solely in Glacier Bay, while 27 (46%) were seen only in Icy Strait. Seventeen whales (29%) were common to both areas. Twenty-five (47%) of the Glacier Bay whales and 10 (17 %) of Icy Strait whales were resident for more than 20 days. Whales were found in an average water depth of 36 fathoms (S=27, range = 5-250), and in a mean sea surface temperature of 8.0 °C (*S* =2.3, range =5-13). Peak whale use of Glacier Bay occurred in July, with most activity concentrated between Whidbey Passage and Point Carolus. Whales were widely scattered throughout Icy Strait in June, but in July and August there was a moderate concentration of whales near Point Adolphus.

INTRODUCTION

The relationship between vessel traffic and whale behavior in Glacier Bay National Park has been a concern since the late 1970's when the possibility of vessel-traffic induced habitat abandonment was first raised (Jurasz and Palmer 1981). Research on whale prey distribution, underwater sound and whale behavior in the presence of vessels attempted to distinguish whether changes in whale distribution were likely linked to prey distribution or vessel impacts. Researchers found that whales change their behavior in the presence of vessels (Baker et al. 1982; Baker et al. 1983; Baker and Herman 1989), and that there is substantial spatial and temporal variability in whale prey distribution (Wing and Krieger 1983; Krieger and Wing 1984; Krieger and Wing 1986). Underwater sound generated by various types of vessels operating at various speeds was also documented (Malme, Miles and McElroy 1982; Miles and Malme 1983). The NPS concluded that any of these factors, alone or in combination, could influence whale distribution

The NPS initiated a humpback whale monitoring program in 1985, to systematically characterize the humpback whale population using the Glacier Bay area, including the number of individuals identified, residence times, spatial and temporal distribution, calf production and feeding behavior. Both Glacier Bay and Icy Strait are studied because whales frequently move between these areas within and between years. Human / whale interactions including strandings, entanglements in fishing gear and vessel disturbance are also documented. As technology has become available, precise locations of whales and their habitat characteristics are now being systematically described as well. Documenting the physical characteristics (e.g. sea surface temperature and water depth) of areas that whales inhabit will allow a more thorough description of whale habitat requirements than is currently available (Jurasz et al, 1981, Dolphin 1987). This is the eleventh consecutive year of consistent data collection on humpback whale population characteristics, although the records of some individual whales go back 22 years to the work of Jusasz and his colleagues (Jurasz and Palmer 1981). This report summarizes the findings of the National Park Service's (NPS) humpback whale

(*Megaptera novaeangliae*) monitoring in Glacier Bay and Icy Strait during the late spring and summer of 1995.

Site fidelity to the study area is high. Approximately 70% of the whales identified in a given year have been identified in two or more years in the Glacier Bay / Icy Strait region (Jurasz and Palmer 1981; Perry et al. 1985; Baker 1986, 1987; Baker and Straley 1988; Straley 1989, 1990; Gabriele 1991, 1992, 1993, 1994) including 15 whales first identified as calves (Gabriele 1995). The whales that use Glacier Bay and Icy Strait are part of the southeastern Alaska feeding herd, estimated at 404 whales (95% confidence limits 350 to 458) between 1979 and 1992 (Straley 1994). The number of whales using Glacier Bay and Icy Strait each year has ranged from 41 to 68, with a mean value of 53.9 and standard deviation of 6.9 (Gabriele 1994), with no obvious increasing or decreasing trend. Variability in whale numbers in the study area does not appear to be attributable to minor variability in monitoring effort (Gabriele et al. 1995a). The proportion of calves in the study population oscillates annually, ranging from 4.5% to 17.6%, coincident with fluctuations in local whale abundance (Baker 1986; Gabriele 1992). Whale movement throughout southeastern Alaska, presumed to be linked with prey availability, seems likely to influence the number of whales in the Glacier Bay area (Baker et al. 1986; Baker et al. 1990; Straley and Gabriele 1995; Straley 1994).

Whales in Glacier Bay and Icy Strait typically feed alone or in pairs, with relatively few larger groups (Baker 1985, Gabriele 1995). However, a distinctive 'core' group of 4-12 whales which feeds cooperatively in Icy Strait has been documented since 1981 (Perry et al. 1985). Whales typically feed below the water's surface, with lunge feeding and bubblenetting observed relatively infrequently. Whales in the study area appear to have preferred feeding partners (Gabriele et al. 1995b) which do not seem related to kinship or the sex of the individuals. Whales in the study area appear to feed primarily on small schooling fishes such as capelin (*Mallotus villosus*), juvenile pollock (*Theragra chalcogramma*), sand lance (*Ammodytes hexapterus*) and herring (*Clupea harengus*) while euphausiids appear to be the predominant prey in areas such as Frederick Sound (Wing and Kreiger 1983; Kreiger and Wing 1984, 1986).

Mature female humpbacks typically reproduce at 2 year intervals (Chittleborough 1958, Baker et al. 1987, Clapham and Mayo 1987, Glockner-Ferrari and Ferrari 1984, 1995). The calving intervals of females in the study area largely follow this trend (summarized in Straley 1994), although a few have been observed with 1 year birth intervals (Straley et al. 1994). One female (#353), 4 males (#516, #186, #352, #1014) and 3 unknown-sex animals (#349, #1042, #1019) first identified as calves have reached breeding age and have thus recruited into the breeding population.

METHODS

Vessel Surveys: The 1995 humpback whale monitoring program was conducted in Glacier Bay and Icy Strait from late May through August. Humpback whales were observed and photographed from a 17' Boston Whaler powered with a 60 hp outboard engine. The main body of Glacier Bay (a rectangle defined by four corners: Bartlett Cove, Point Carrolus, Geikie Inlet and Garforth Island) was surveyed approximately 3 days per week. Surveys of the upper bay were conducted when whale sightings were reported by other vessels. Upper bay surveys extended as far north as Russell Island in the West Arm and Adams Inlet in the East Arm. Icy Strait surveys were performed approximately once per week, with the greatest survey effort along the shoreline of Chichagof Island from Mud Bay to Burger Point, although several surveys included Lemesurier Island, the mouth of Idaho Inlet and the north and west shorelines of Pleasant Island. Icy Strait surveys also resulted in a survey of the mouth of Glacier Bay, because that area is crossed in transit from Bartlett Cove to Icy Strait.

Surveys were not conducted in the same area on consecutive days, to minimize the potential impact that monitoring efforts might have on the whales. However, on occasions when circumstances such as time, weather, or the presence of other vessels prevented whale identification photographs from being taken, consecutive surveys of the same area were made. Table 1 shows the number of surveys per month in Glacier Bay and Icy Strait in from 1985-1995. Table 2 shows 1985-1995 hours of search and observation time.

When whales were found, the observer recorded the latitude and longitude position at the start of observation, which was determined with a Magellan NAV1000 Global Positioning System (GPS) using the NAD27 datum. The observer also recorded other sighting data in field notes, including the number of whales, a general description of whale behavior, water depth, sea surface temperature, environmental conditions and whale identity if known. A hydrophone and DAT deck were used to monitor and record underwater sounds.

Individual Identification: Whale fluke photographs were taken with a Nikon 8008 camera equipped with a motor drive, databack, and 300 mm lens. High speed (1600 ASA or 400 ASA pushed to 1600) black and white film was used to obtain clear photographs of the ventral surface of the tail flukes of each whale. Each whale's flukes have a distinct black and white pigment pattern that allows individual identification (Jurasz and Palmer 1981; Katona et al. 1979). Photographs of the dorsal fin supplemented the identification of individuals. The film was processed and printed by Panda Lab in Seattle, Washington. Contact sheets and field notes were analyzed to determine the dates that each whale was photographed. The season's best photograph of each individual was printed and catalogued.

Photographs of individuals were compared to previous NPS photographs and to available catalogs (Jurasz and Palmer 1981; Perry et al. 1985; Perry et al. 1988; von Zeigesar 1992) to determine the identity

Table 1. Number of humpback whale survey days per month in Glacier Bay and Icy Strait, 1985-1995

ar	Glacier Bay					Icy Strait				
	May	June	July	Aug	Sept	May	June	July	Aug	Sept
1985	0	10	11	10	0	0	7	4	3	1
1986	0	13	17	6	0	0	5	3	6	2
1987	3	12	12	5	1	2	5	7	7	2
1988	0	11	12	12	7	0	5	7	5	3
1989	3	17	14	16	1	1	6	6	7	4
1990	6	16	18	14	0	4	5	6	8	0
1991	7	14	17	13	6	3	7	6	4	3
1992	3	19	17	12	7	2	4	5	4	1
1993	2	10	13	7	1	1	3	3	5	1
1994	1	9	10	13	1	0	5	4	8	1
1995	3	10	11	10	2	2	4	4	7	2

Table 2. Total search and encounter time in Glacier Bay (GB) and Icy Strait (IS), 1985-1995

Year	GB (hrs)	IS (hrs)	Total (hrs)	Total Whale Count (GB and IS)
1985	234	92	326	41
1986	-	-	-	51
1987	-	-	-	59
1988	199	108	307	55
1989	231	123	354	42
1990	215	115	330	50
1991	256	100	356	52
1992	248	71	319	68
1993	192	62	254	51
1994	171	92	263	63
1995	181	99	280	58

Note: Hours of effort data for 1986 and 1987 are not available.

and past sighting history of each whale. Many whales are referred to by an identification number issued by the Kewalo Basin Marine Mammal Laboratory (KBMML) catalog of North Pacific humpback whales (Perry et al. 1988). Whales first photo-identified by Jurasz and Palmer (1981) are also referred to by their nicknames. Identification numbers smaller than ID# 950 coincide with those in the KBMML catalog, but those ID#s greater than 950 are unique to Glacier Bay National Park's catalog.

Whales that had not been previously identified in Glacier Bay and Icy Strait were assigned a temporary identification code, for example GB 93-01, indicating the year (1993) and location (GB) of the sighting. Temporary codes were replaced with permanent identification numbers if the whale was identified on more than day, or if it had been identified elsewhere or in previous years. Calves were assigned ID#s if adequate photographs of the flukes were obtained. After photographic analysis was complete, the whale's identity and sighting data from the field notes were added to a Foxpro computer database containing Glacier Bay and Icy Strait whale sighting histories from 1977 to 1995.

Whale Counts: After all photographs were analyzed, the number of distinct individual whales in the sample was counted. Separate counts were made of Glacier Bay and Icy Strait, for the total monitoring period and for a 'standardized period' (after Perry et al. 1985), from 9 July to 16 August. The standardized period was chosen by Perry and co-workers (1985), to coincide with the study dates in 1982-1984, so that valid comparisons of counts between years could be made. Although the standardized period is substantially shorter than the current NPS monitoring season, and the beginning and ending dates have no particular biological significance, the standardized counts tend to reflect trends in total counts relatively well (Gabriele et al. 1995a). Continued use of the 'standardized period' is currently the only way of comparing whale counts in 1982-1984 to subsequent years (Gabriele et al. 1995a). The number of 'resident' whales was also counted. A whale is defined to be resident if it was photographically identified in the study area over a span of 20 or more days (Baker 1986).

Habitat Characteristics and Prey Assessment: Surface temperature and water depth were measured with a Raytheon V850 dual-frequency color video echo-sounder at the start of each pod observation. The temperature sensor was calibrated with a scientific thermometer and agreed within 0.1 ^{o}C. Depth measurements were rounded to the nearest fathom. The depth, density and morphology of prey patches appearing on the echo-sounder screen were qualitatively described in the observer's field notes. Color slides (200 ASA, shutter speed 1/30) of the echo-sounder screen were taken to capture particularly interesting images. Gain and chart-speed settings were standardized (gain for 50 kHZ and 200 kHz transducers were set at 75%, chart speed was set at 9) to ensure that images observed on different sampling occasions would be comparable. When possible, prey type was determined visually or sampled with a dip net in the vicinity of feeding whales.

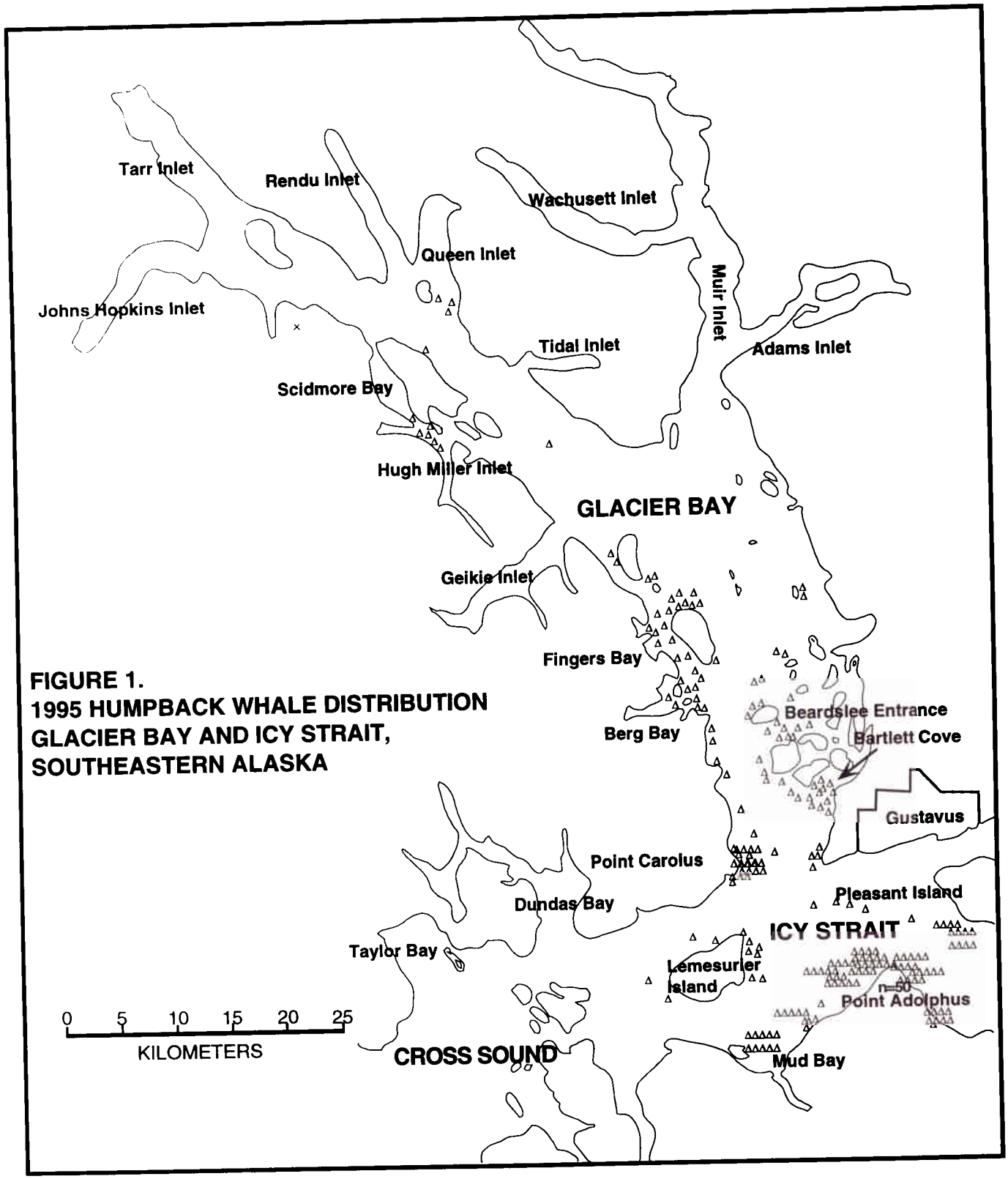


FIGURE 1.
1995 HUMPBACK WHALE DISTRIBUTION GLACIER BAY AND ICY STRAIT, SOUTHEASTERN ALASKA

RESULTS

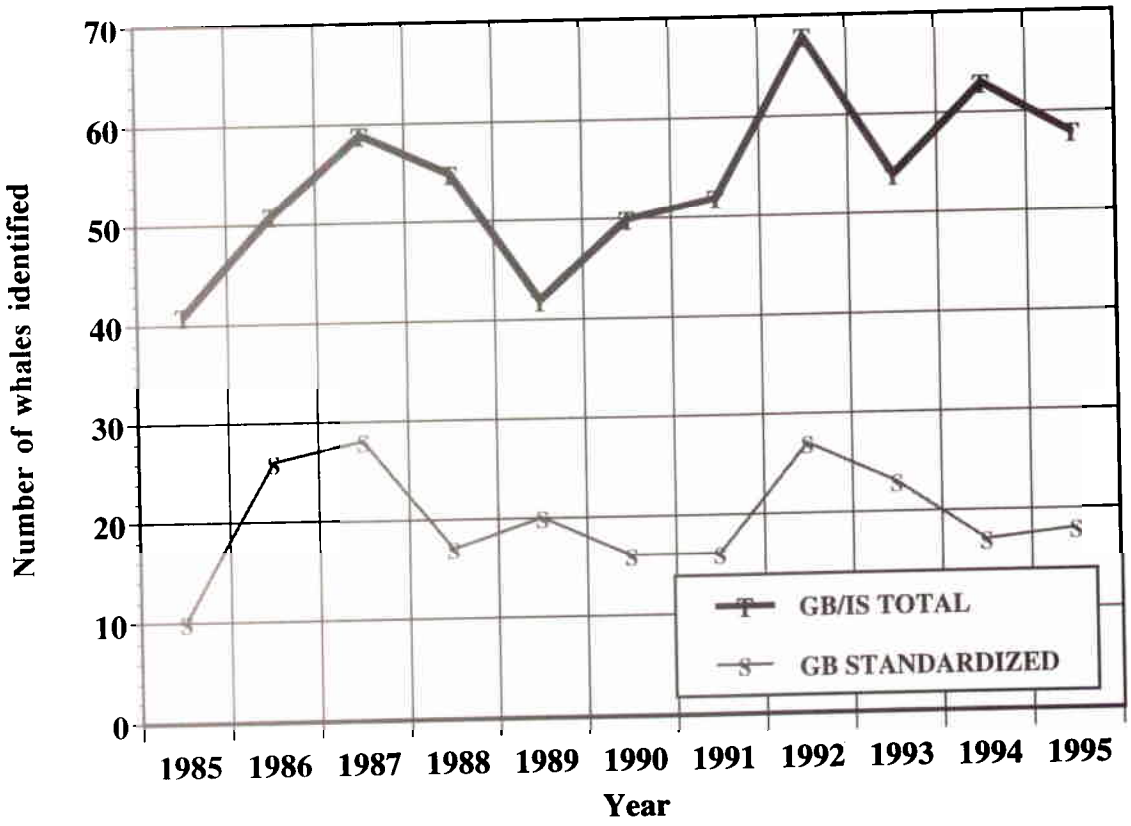
Whale Counts: A total of 58 individual humpback whales were photographically identified in Glacier Bay and Icy Strait between 26 May and 31 August 1995 (Table 3; Figure 2). Of this total count, 17 whales (29 %) were common to both areas. Twenty-seven whales, including the 3 cow/calf pairs, were sighted exclusively in Icy Strait and 13 were observed exclusively in Glacier Bay. Limiting the count to those whales seen during the standardized period from 9 July to 16 August (Perry et al. 1985), yielded a standardized count of 18 whales in Glacier Bay, 26 in Icy Strait (Table 3),and a total of 37 for Icy Strait and Glacier Bay.

Table 3. Standardized and total counts of humpback whales in Glacier Bay and Icy Strait, 1982-1995

Year	Glacier Bay		Icy Strait		Glacier Bay & Icy Strait	
	Standardized Count	Total Count	Standardized Count	Total Count	Standardized Count	Total Count
1982	22	22	5	15	33	33
1983	10	10	9	9	17	17
1984	24	25	21	22	39	39
1985	10	15	19	30	27	41
1986	26	32	27	35	42	51
1987	28	33	34	48	49	59
1988	17	39	29	36	41	55
1989	20	24	19	30	33	42
1990	16	26	24	34	36	50
1991	16	19	34	40	45	52
1992	27	35	38	51	51	68
1993	23	31	25	33	42	54
1994	17	32	29	42	44	63
1995	18	28	26	45	37	58

Note: Total counts refer to the number of whales (adults and calves) identified during the entire monitoring season. Standardized counts refer to the number of whales sighted between 9 July and 16 August each year. The combined count for Glacier Bay and Icy Strait is typically slightly smaller than the sum of Glacier Bay and Icy Strait counts, because some whales are identified in both areas.

Figure 2. Number of whales identified in Glacier Bay and Icy Strait: 1985-1995



Seasonal Distribution: Whales were observed and identified throughout Glacier Bay and Icy Strait (Figure 1). Whale numbers in Glacier Bay increased slowly in June, with whales scattered throughout the Bay. A few whales were sighted consistently in Bartlett Cove in June. By early July, 5 or more whales concentrated in Whidbey Passage, primarily at the mouths of Berg Bay and Fingers Bay, and along the north shore of Willoughby Island. Throughout July, whales congregated near Point Carolus, and most Glacier Bay whales were distributed along the shore between Point Carolus and Berg Bay. The shores of eastern Glacier Bay, Beardslee Entrance, Lester Island and Young Island appeared to be less populated with whales than usual. The first whale identified in Glacier Bay was whale #1018, north of Blue Mouse Cove on 21 May. Whale #1018 was resighted in the West Arm throughout the summer; and was frequently sighted in Scidmore Bay with 3 year old #1079 in July and August. The highest number of whales identified in a single Glacier Bay survey was 9, on 5 July.

Icy Strait whales were widely scattered, with a moderate degree of concentration near Point Adolphus. In early June, a large group of whales was observed lunge feeding at Pleasant Island reef. Most of the individuals in this group were not identified again during the season, and only a few whales were observed at Pleasant Island during the rest of the summer. Point Adolphus had a very sparse whale presence in June, but whales began to use the area more frequently in July and August. Many whales were dispersed west of Point

Carolus and around Lemesurier Island in June and July. The highest number of whales identified in an Icy Strait survey was 19, on 8 June.

Local Movement and Residency: Seventeen whales (29% of all identified whales) were sighted in both Icy Strait and Glacier Bay, with 7 individuals (12%), making one or more round trips between areas (Appendix 1). Twelve (42%) of the 28 whales that entered Glacier Bay remained 20 or more days long enough to be considered resident (after Baker et al. 1983). Eleven of the 45 (24%) Icy Strait whales were considered resident in that area during the study. Using the same 20 day residency criterion, 27 of 58 (46%) whales were resident in the combined Glacier Bay - Icy Strait area.

Habitat Characteristics and Prey Assessment: Sea surface temperature and water depth were measured for 142 pods observed in 1995. Groups of whales were found in an average water depth of 36 fathoms (s=27, range = 5-250, Figure 2). The mean sea surface temperature at locations where whales were observed was 8.0 °C (s =2.3, range =5-13, Figure 3). Potential humpback whale prey appeared to be distributed throughout the water column, but were primarily in scattered patches or linear layers of various densities in mid-water. Whales were presumed to be feeding on the potential prey patches that were observed with the echo-sounder, although it was not possible to confirm this.

Figure 3. Water depth at locations where whales were observed: 1993-1995

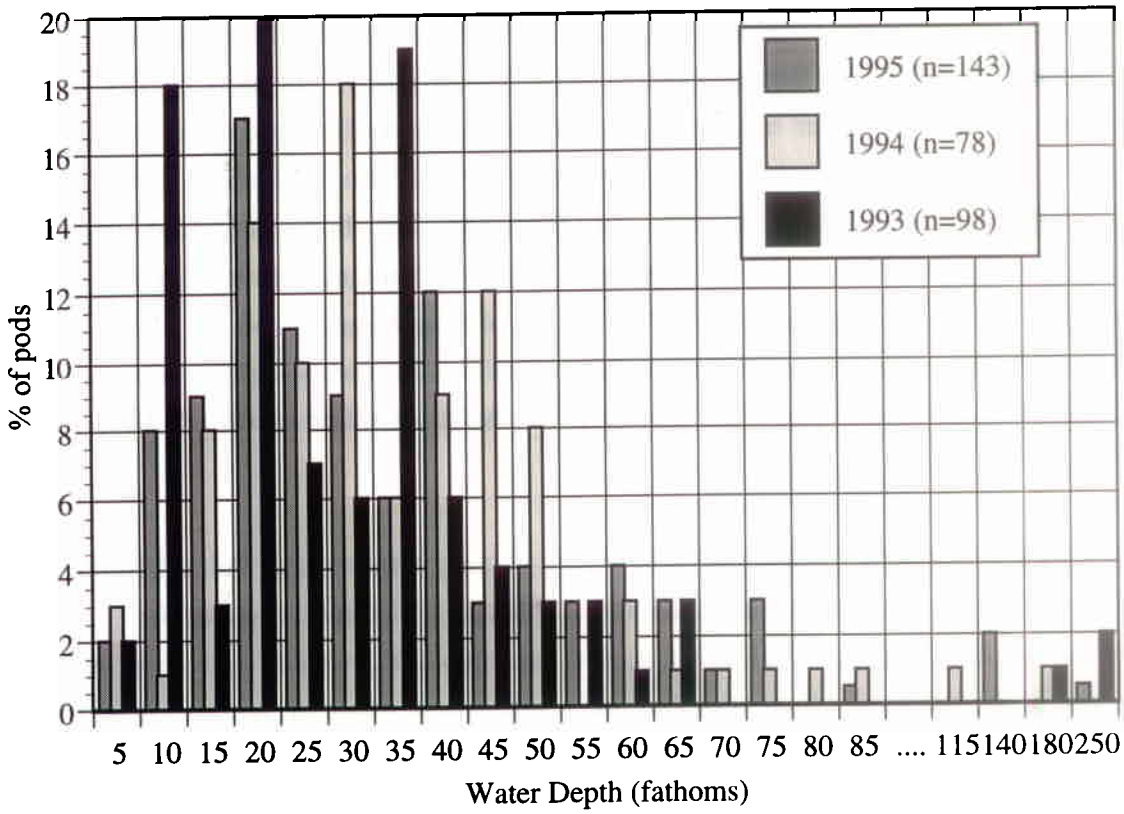
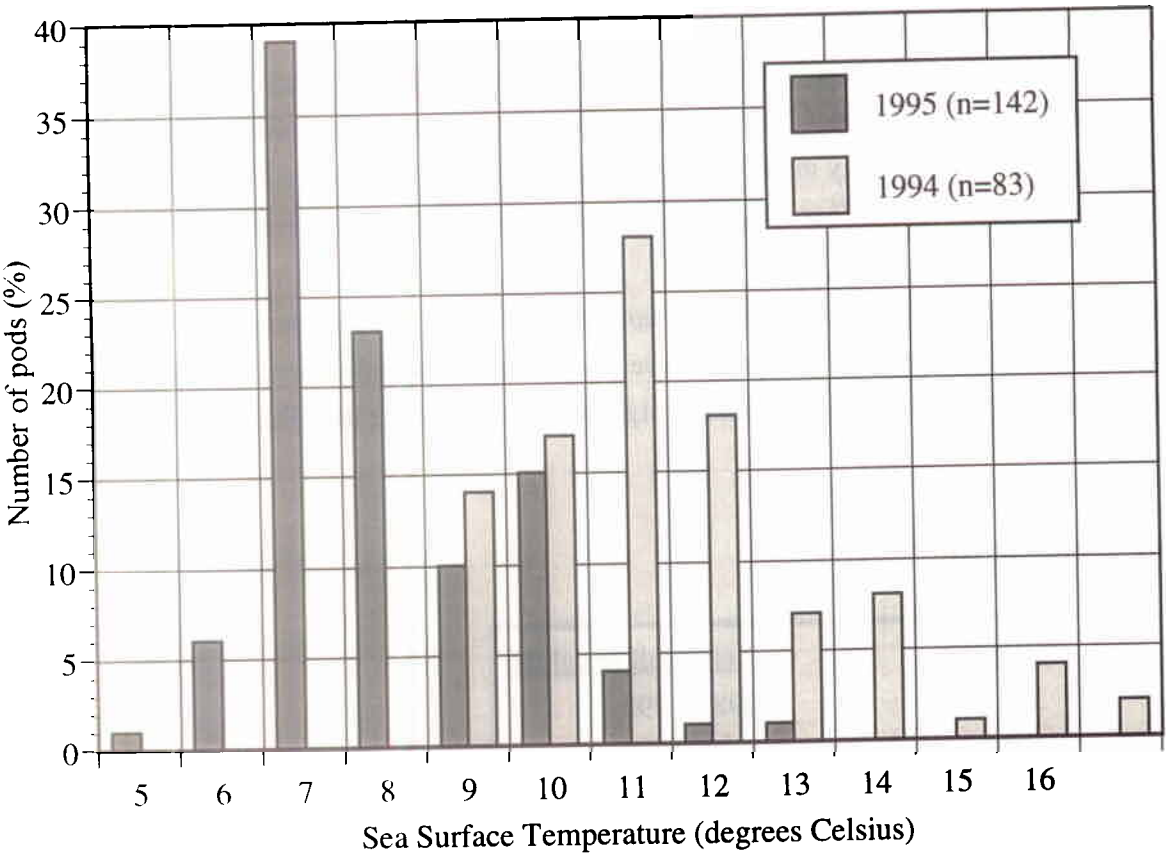


Figure 4. Sea surface temperature at locations where whales were observed: 1994-1995



Feeding Behavior: Most whales in Glacier Bay and Icy Strait foraged alone or in groups containing 3 or fewer whales. Most whales appeared to feed below the water's surface, with no obvious surface component to their behavior. Although sub-surface feeding was the most common feeding mode observed, single whales were observed lateral and vertical lunge feeding on 19 occasions near Willoughby Island, Mud Bay and Scidmore Bay. In 6 of these cases, the whales' lunges were preceded by one or more bubble clouds. Single whales were observed bubblenet feeding twice in Glacier Bay and twice at Pleasant Island. In 2 of these cases, the bubble-netting whales vocalized prior to surfacing; a third case was acoustically monitored but no vocalizations were heard. The sounds recorded resembled the sterotyped 500 Hz frequency modulated "feeding call" described by other researchers (Baker 1985, D'Vincent et al. 1985, NPS unpublished data). A group of 10 whales was observed vertical lunge feeding at Pleasant Island reef on 8 June. Coordinated sub-surface feeding by typical members of the 'core group' (Perry et al. 1985) at Point Adolphus was first observed on 19 July and continued through August.

Reproduction and Juvenile Survival: Three cow/calf pairs were identified in the study area in 1995 (Appendix 1). Cow #581 and her calf were observed twice in Icy Strait in late spring. The calf did not show

its flukes and was therefore not photographically identified. Cow #581 has twice had calves in three successive years (1987-1989 and 1993-1995), shown in Table 4. Cow #1077 was observed in a large, lunge feeding group at Pleasant Island on June 8. During most of the observation, her calf, (#1239) was tail-slapping and breaching nearby. Cow #1077 was identified as the mother when she left the group and retrieved the calf, bringing it back into the group. Whale #1077 was not previously known to be female. Cow #941 and her calf (#1238) were identified in Icy Strait on one day in early August. Several whales that were first identified as calves were re-sighted in 1995, including the first resighting of #1079, the 1993 calf of female #235.

The crude birth rate (CBR) of the study population, computed by dividing the number of calves by the total number of whales, provides a measure of the reproductive rate for the local population. The CBR for 1995 was 5.2%, continuing the long sequence of alternating high and low CBRs for the Glacier Bay/Icy Strait area (Table 5).

Table 4. Reproductive history of cow #581

Year	Calf ID#	Years calf resighted
1984	353	1987-1995
1987	1042	1990-1992
1988	1032	none
1989	1017	none
1991	1058	none
1993	1081	none
1994	1089	none
1995	no photo	n/a

Note: Only calves whose flukes were photographed received an identification number.

Whale / Vessel Interactions: No humpback whale entanglements or collisions with vessels were observed or reported in Glacier Bay or Icy Strait in 1995. In Glacier Bay, vessels were reported on several occasions in close proximity to whales in Sitakaday Narrows and near Russell Island. In Icy Strait, changes in whale behavior (i.e. breaching and/or tail slapping) that appeared to be linked to the presence and/or behavior of one or more vessels were observed on 4 occasions (19 July, 1 August, 11 August and 23 August). For example, on 1 August, a single group of 6 humpbacks was surrounded on 3 sides by 9 vessels near Point Adolphus. The whales breached repeatedly and travelled rapidly during dives, changing directions frequently. The travel speed and amount of aerial behavior seemed atypical of the group, and may have been related to

vessel presence. Although in this example the ratio of vessels/ whales may seem extreme, the amount of whale-watching in Icy Strait by kayaks, skiffs, charter vessels, tour boats and cruise ships appeared comparable recent years.

Table 5. Crude birth rate of humpback whales in Glacier Bay and Icy Strait, 1982-1995.

Year	#Whales	#Calves	CBR %
1982	33	6	18.2
1983	17	0	0
1984	39	7	17.9
1985	41	2	4.5
1986	51	8	15.7
1987	59	4	6.8
1988	55	8	14.5
1989	42	5	11.9
1990	50	6	12.0
1991	52	4	7.7
1992	68	12	17.6
1993	54	3	5.9
1994	63	9	14.3
1995	58	3	5.2

Note: #Whales = total number of Glacier Bay and Icy Strait whales (including adults and calves), #Calves = number of calves, CBR % = crude birth rate, a percentage computed by #Calves / #Whales.

Other Observations: On 3 July, 4 humpbacks were feeding on shallow prey near Point Carolus when a group of approximately 20 killer whales (*Orcinus orca*) came into the area. Three of the humpbacks immediately disappeared from the area, and the fourth animal (male #118) remained. After the killer whales had milled in the area for about 5 minutes, a sub-group of approximately 6 killer whales surrounded whale #118 and appeared to 'harass' him. While he was surrounded, whale #118's respirations were wheezy and he repeatedly slashed his pectoral fins and tail from side to side. The killer whales stayed with the humpback for about 5 minutes, which remained on the surface throughout the incident. The humpback then resumed feeding nearshore, and the killer whales eventually headed north into Glacier Bay. Identification photographs of the killer whales were taken, and later identified as resident-type AG pod, (G. Ellis, pers. comm.).

DISCUSSION

Whale Counts: The count of 58 humpback whales identified in the study area in 1995 was the fourth highest since 1985, (Table 3) and slightly above the 1985-1994 average of 53.9. The proportion of resident

whales in Glacier Bay was typical of previous years at 42%. The mean proportion of Glacier Bay residents 1985-1995 is 40.8%, (s = 10.6). The mean proportion of whales that were identified in both Glacier Bay and Icy Strait in a given year, 1985-1995 was 24.3% (s = 7.8), making the 1995 figure of 29% slightly higher than usual. None of these figures seems remarkable, given previous variability in the parameters. However, a more rigorous, quantitative analysis of this time series data would be useful.

Distribution: The north/south distribution of whales in Glacier Bay was typical of previous years, but the Bay's eastern shore, particularly in the lower Bay, seemed to be used less than in previous years. This observation is not likely due to different levels of effort, because the observers balanced survey effort throughout the main body of Glacier Bay, regardless of whale distribution. The concentration of whales from Whidbey Passage to Point Carolus in July corresponded to the peak numbers of whales observed in the study area. Like last year, Icy Strait whales were widely distributed in June and July with many individuals scattered around Lemesurier Island. A few whales were present at Point Adolphus in May and June, but the peak whale aggregation and the 'core group' seemed to form later than in previous years. Dense schools of what appeared to be potential whale prey were observed on 11 July at Point Adolphus, prior to the apparent arrival of most whales.

The prevalence (i.e., number of sightings) of the core group varies each year. In 9 of the past 10 years, the core group was sighted from early June through August (NPS unpublished data). The initial core group sighting on 19 July this year is markedly later than usual. Although the core group is believed to be less cohesive in years when one or more female group-members is accompanied by a young calf (Perry et al. 1985), none of the core group females was observed with a calf this summer. Although the factors that delayed the core group's appearance this year are unknown, overall whale activity near Point Adolphus appeared to increase at about the same time. These observations could indicate a temporal shift in prey abundance, but in absence of quantitative data, it is impossible to be sure.

Feeding Behavior: Most whales foraged alone, as typical of previous observations (Baker 1985, Gabriele 1995) with a relatively high degree of lunge feeding, as reported in some previous years (Straley 1989, Baker 1986, Baker 1985). However, it is notable that 6 occurrences of bubble feeding, including 3 confirmed occurrences of bubblenet feeding were observed. Bubblenet feeding has been confirmed on only a few occasions (Baker 1987, Straley 1989, Gabriele 1993) since the late 1970s (Jurasz and Palmer 1981). The vocalizations recorded from the two bubblenetting whales are also quite interesting because nearly all previously reported observations of the sterotyped feeding call were in groups of whales (Baker 1985, D'Vincent et al. 1985, NPS unpublished data). Researchers have speculated whether the vocalization serves in group coordination or prey manipulation (D'Vincent et al. 1985, Baker 1985). The feeding calls recorded from the 2 single animals corroborates the hypothesis of vocal prey manipulation.

Habitat Characteristics and Prey Assessment: As previously noted (Straley 1989, Gabriele 1994), nge feeding in the study area seems associated with shallow prey. A focused study of the correlation .tween prey characteristics and a detailed record of whale respiration and behavior, would add a great deal to current knowledge of humpback whale foraging ecology. The systematic use of the 50/200 kHz depthsounder during whale observations has revealed potential prey at various depths and in a variety of configurations (see also Gabriele 1993, 1994). Summaries of the data collected in 1993-1995, to determine the average depths and morphologies of prey aggregations, correlated with recent and historical data on water depth and sea surface temperature (Jurasz et al. 1981; Dolphin 1987), are planned for 1996.

Reproduction and Juvenile Survival: Cow #581 has had 3 successive calving years twice in her history (Table 4). Cow #581's reproductive rate is noteworthy because annual reproduction is infrequent in female humpback whales (Glockner-Ferrari and Ferrari 1984, 1995; Baker et al. 1987, Clapham and Mayo 1987, Straley et al. 1994) although several occurences have been documented in summer and winter grounds. To address this and other questions regarding reproductive parameters, a collaborative study of southeastern Alaska humpback calving intervals is planned for 1996. The reasons for the oscillation of the annual crude birth rate figure (Table 5), are still unknown, although its correlation with population numbers, population composition and a similar phenomenon in Prince William Sound (Dahlheim and von Zeigesar 1993), need to be investigated.

Ongoing monitoring and research will help the NPS to address continuing vessel management issues in Glacier Bay National Park. Regulations prohibiting whale approaches and regulating vessel numbers and operations in Glacier Bay have been in effect since 1980 (Federal Register 45 32228, May 15, 1980). However, changing vessel numbers and characteristics have highlighted the need for continued evaluation of management practices. In some cases, new studies are needed, such as acoustical studies of vessel-generated noise, or quantitative studies of marine resources, and in other cases, analysis of existing data would be the place to start. Analysis of whale monitoring data to evaluate trends in whale numbers, residence characteristics and reproductive parameters are planned for 1996.

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